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Notes on Alabama Plants.

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TALINUM.

Dr. Charles Mohr in the Systematic Catalogue of his principal work, the Plant Life of Alabama, which appeared in 1901 as Vol. VI., Contributions from the U. S. National Herbarium, includes *Talinum teretifolium* Pursh as a member of the Alabama Flora. He mentions[1] four counties where the species is definitely known to have been discovered, and indicates its restricted distribution there with the remark "not frequent, local." The counties mentioned lie in two distant sections of the State; the one in the central part of Northern Alabama, the other in the Eastern central part of the State. Three of the four counties, which are adjoining, are located in the former section, viz., Walker, Blount, and Cullman. Special localities are given for Walker and Blount Counties, none for Cullman. In the other section, a single station, Baldrock in Clay County, is mentioned. The elevation of this last being specified as 2200 feet, against 800 for Cullman and 1000 for Blount County.

For the present it is not my purpose to discuss the identity of the plants for the State in general with *Talinum teretifolium* Pursh as I have not had an opportunity of examining specimens from the several localities preserved in the herbarium of the Geological Survey of Alabama. I cannot, however, wholly refrain from touching on the matter in so far as Cullman County is concerned, for I have discovered a species distinct from the *Talinum teretifolium* Pursh though closely related to it. Unfortunately Mohr does not specify a definite locality for Cullman County. The statement of altitude, however, is of some value, for it shows that crests of higher elevation were not the station or stations where

[1] l. c. p. 496. 1901.

the plant was discovered, but that he refers only to the approximate level of that table land which is about 800 feet above sea level.

A second remark of Mohr has an indirect bearing on the question, and seems to support the suspicion that the plant reported from this part of the State is perhaps identical with the *Talinum* of my own discovery, and that it was confounded with Pursh's *Talinum teretifolium*. He credits the discovery of the plant in this locality to the Misses Emily and Mary Mohr. Now these ladies lived in the central part of the county, a mile or so distant from Cullman, and close to the Little River (Eight Mile Creek) where it flows through the premises of St. Bernard College. Not very far east of the College grounds, the banks of the stream,—'river' is a misnomer,—become cliffy, the place being commonly known as "The Cliffs." It is from this station that I secured my plants, and, in my mind, there is little doubt that it is likewise the place where the Misses Mohr made their discovery.

That the plant from this locality might have passed without critical examination as *Talinum teretifolium* is not very surprising; first, because this was considered the only species in the North, as well as in the South Eastern States; secondly, because of the short diagnosis which was considered sufficient by the earlier authors. Pursh's[1] classical diagnosis, "*T. foliis cylindricis carnosis, corymbis terminalibus pedunculatis*," is such that it applies equally well to any species with terete leaves and a terminal peduncled inflorescence, here termed a corymb, but in reality a cyme.

In Chapman's Flora, formerly the leading manual for the South, no character is mentioned which would be of any use in the present case. In Gray's well known Manual of Botany[2] of the Northern United States, mention is made of one character which proves of value in point of comparison, viz., the varying number of stamens in the species *Talinum teretifolium*, limiting them from 15-20. This limiting of the number of stamens is in strong contrast with that found in the plant which I have discovered in Cullman County, in which the minimum is above forty. This difference, it seems should have aroused suspicion regarding the identity of the plant with *T. teretifolium* Pursh. Too much emphasis, however, must not be laid upon this point, for every practical taxonomist knows that the first statement about a limit, in case of variable characters,

[1] Pursh Fl. Am. Sept. 2; 365. 1814.

[2] A. Gray Man., 5th ed. p. 98.

is not necessarily very reliable, and, not infrequently, must be accepted with caution. Such a character, however, may become very valuable in the course of time if it proves constant under further observation.

Robinson and Fernald's Gray's New Manual confirms the constancy of the limit as stated in Gray's older manual. The same limit—15-20—is mentioned in Small's Flora of the South Eastern United States,[4] but with the restricting remark "usually." It is not clear whether this "usually" refers to an occasionally lower or higher number, but the former seems more probable when we refer to the key, which reads, "stamens less than 25." In Britton's works, the Manual of the Flora of the Northern States,[5] and the Illustrated Flora, the limit is extended both ways, viz., 10-30, against Gray's 15-20. Another good character is mentioned in these works, viz., the length of the style as compared with that of the stamens. This character with that regarding the number of stamens unquestionably makes the plant from the Cliffs on the Little River in Cullman County a species distinct from *Talinum teretifolium* Pursh.

The species is easily recognized by: stamens more than 40; style protruding beyond the stamens about as much as their respective length; petals 9-13 mm. long. It becomes then

Talinum Mengesii, spec. nov.

Type specimen in Herbarium St. Bernard College, no. 1668.

Plant succulent, glabrous, 2-4 dm. tall, perennial by a short horizontal rootstock which is sometimes branched, or. the innovations arise from a very short vertical caudex; roots slender, fibrous, Stems tufted, generally few or single, 3-10, or rarely up to 15 cm. high, unbranched for almost the whole length, the one to five branches arising from near the top just below the base of the long wiry peduncle by which the stem is terminated. The branches, from a few to 10 cm. long, are often branched again at their ends from below the secondary peduncles, but these secondary branches generally do not develope beyond the phase of fascicled leaves, in other cases, however, grow to normal size and terminate into peduncles. The leaves are quite numerous but not crowded on the stem and branches, terete, 2-5.5 cm. long, 1.5-3 mm. thick, not

[4] Small's Fl. S. E. U. S. p. 440. 1903.

[5] Brit's. Man. N. U. S. & C. p. 385. 1905.

dilated at the base, the backward prolongation less than 1 mm. long, the apex bluntly pointed. The scape-like peduncles are slender but stiff and wiry, 7-20 m. long; the cyme is open and only occasionally corymbosely branched, but as a rule is umbellate, having generally three branches, which are from a few to 12 cm. long and radiate from below the central flower; the bracts are hardly 2 mm. long, inclusive of the posterior prolongation and are lanceolate-ovate; the pedicels are clavate and 5-10 mm. long. The sepals are 3, 5-4 mm. long about one third as long as the petals, ovate, obtusish. The corolla is rose-purple; the petals are mainly obovate, mucronulate, 9-13 mm. long, closing again after spreading for one day or some hours, withering, and at length, like the sepals, deciduous. Stamens 45-100, or occasionally a few more, but most commonly 50-80; filaments distinct, not adnate to the base of the petals, purple; anthers golden yellow. Style distinctly excerted beyond the stamens about as much as their own average length. Capsule 3-4 mm. high, subglobuse, angled at the sutures, 3-, or sometimes, 4- valved. Seeds 1 mm. wide, black, almost smooth, and slightly shining.

The plant in this station has little chance of holding its place in the far future which it once occupied in the past, namely, on the cliff bank of the Little River. The inhabited locality is already broken up into separated patches, the plant being now replaced by various species which were unable to adapt themselves to the formerly prevailing conditions. *Talinum Mengesii* is a plant content with a scant accumulation of soil on the exposed naked surface of the rock, sometimes establishing itself in such small quantities of soil that it cannot produce a proper rootstock for the first time because of insufficient protection. The accumulating soil is rich in organic matter, but I have seen plants flourishing equally well in pure sand, in a somewhat lower situation about an abandoned stone crushing mill. The plant frequently roots between the decomposing bases of xerophile bryophytes of an upright habit, which form patches on the rocks, from a hand's space to a few square feet, and offer a good protection for the plant's rootstock. In such situations the plant grows with practically no soil. But even in cases of a more upbuilt soil, this is rarely more than 1 cm. deep. Not so content is the plant in as far as light is concerned, for it is dependent on bright open sunshine, and this, under the circumstances of advanced soil conditions is its misfortune in the

resulting competition. When the soil is about one cm. deep, sooner or later, accommodation of flowering plants other than *Talinum Mengesii* sets in. The first one which associates with this species is *Alsinopsis glabra* Small (*Alsine glabra* Michx.), yet, at least for the first, without interfering with the flourishing of the *Talinum Mengesii*. Because the former plant is a slender open branched, wiry, and rather short living annual with but a few small leaves, no serious overshading or crowding is effected, and thus both species tolerate one another very well. Yet the appearance of this species is a sign that the time is near at hand when *T. Mengesii* is doomed to give up its habitat. By and by other species, well fitted to form a closer plant association in a still scanty soil, begin to establish themselves with *Talinum Mengesii* and *Alsinopsis glabra*. Among the first of these are *Crotonopsis linearis* Michx., *Sarothra gentianoides* L., *Polygala Curtissii* A. Gray, *Allium microscordion* Small, etc. These are all sun loving plants, but unlike *Talinum Mengesii*, they maintain themselves well in the grassy swales which now establish themselves on the formerly barren rock, whence that species in this time of progression has already been outcrowded.

ARUNDINARIA TECTA (WALT) MUHL.

It is rather universally known that *Arundinaria tecta* like the other North American species *A. macrosperma* Michx. does not as rule flower each succeeding year, but remains sterile for longer or shorter periods, generally producing flowers only at intervals of several or even many years. However, such a uniform conception does not prevail in regard to the arrangement of the inflorescence on the plant, i. e.,—that part of the plant upon which the flowers are borne. The interpretation of the leading manuals of the Eastern flora is responsible for this difference of opinion on the character in question. This is to be regretted the more since it is a case in which the majority of botanists are unable to obtain first hand information through actual observation because of the two factors, namely; the sterility and the restricted habitat of the plant.

Curiously enough the uncertainty arises in the diagnosis found in the descriptions of *Arundinaria tecta* given by the authors of the newer manuals, viz.—Gray's New Manual, Britton's Manual of the Flora of the U. S., and Small's Flora of South-Eastern U. S., while in the older manuals, viz.—Gray's Manual, and Chapman's Flora, the diagnosis of the point in question is far more complete.

For clearness' sake let me give an example: In the fifth edition of Gray's own work, Manual of Botany,[1] that part of the description which relates to the inflorescence reads, "spikelets solitary or in a simple raceme at the summit of the branches or frequently on leafless radical culms." At the end of this text we find the word "*Chapman*" and from this we learn that the foregoing statement is not based on Gray's own observations, but that it is accredited to the authority of Chapman. Thus it might seem that the citation of the diagnosis should have been more justly quoted from Chapman's own work, but let me emphasize the fact that Gray himself is not guilty of the violation attributable to the recent authors whose work sails somewhat under the protection of Gray's authority, since his name is associated with the title of the book. The wording in Chapman's original work, The Flora of the Southern United States,[2] is literally the same and needs no repetition.

Upon Chapman's authentical and precise diagnosis we must assume that the flowers may appear on both parts of the plant, namely, on the branches of the leafy culms and on the distinct radical culms. The text in Robinson and Fernald's Gray's New Manual[3] reads, "panicles of few spikelets on long slender branches." The wording differs from that of the old Manual but it does not interfere in our case, for only the words "on branches" relate to the point in question. A comparison with Chapman's text, as adopted by Gray in his own publication, shows that only a part of the diagnosis has been retained by the authors of the New Manual, i. e., that the inflorescence is borne on the branches. The part relating to the radical culms is entirely discarded.

Consulting leading manuals of another school, we find a statement contrary to the one found in "Gray's New Manual." This, however, is a part of Chapman's diagnosis, the very part which the authors of Gray's New Manual have rejected. The works referred to are, "Britton's Manual of the Flora of the Northern United States and Canada" and Small's "Flora of the Southeastern United States." In Britton's Manual[4] the text reads, "racemes on short leafless culms;" in Small's Flora,[5] "inflorescence borne on short leafless stems."

Thus it is obvious that neither in the so called Gray's New Manual nor in the other two works, Britton's Manual and Small's

[1] l. c. p. 98. [2] l. c. p. 561. 1882.
[3] l. c. p. 171. 1908. [4] l. c. p. 158. 1905. [5] l. c. p. 161. 1903.

Flora is a character found which is not included in Chapman's diagnosis, and to which Asa Gray faithfully adhered in the publication of his own Manual. This only is new and strange, viz., that Chapman's diagnosis has been divided. The authors of the one school made part of his statement their own, while those of the other school were content with the rest of it.

This violation of Chapman's diagnosis becomes more pronounced from the fact that in Britton's Manual,[1] and also in Small's Flora,[2] the retained part is made use of as a specific distinction in connection with the size of the plant, for the key presented with the genus Arundinaria reads:

"Spikelets borne on radical shoots of the year; culms 4 m. tall or less,—1 A. tecta.

Spikelets borne on the old stems; culms 5 m. tall or more,—2 A. macrosperma."

The above citation is from Britton's work and is identical with that found in Small's Flora in regard to *A. tecta*, and almost the same in regard to *A. macrosperma*. But Chapman's full text on this part is; "frequently on leafless radical culms." Now, it is logically not the same to simply state "on radical shoots" in place of "frequently on . . . radical culms." The rejection of the word "frequently" becomes almost a necessity in order to make the character a specific distinction.

Now, although the authors of these recent manuals (Hitchcock is credited with having elaborated the *Gramineæ* in Gray's New Manual, Nash, this same family in Small's Flora) have reached conclusions which led to the discarding of a part of Chapman's diagnosis as a result of actual observations or, examination of herbarium material, this does not justify their rejection of either of the two characters for the very reason that the species is an exceptionally rare object of observation in the flowering state. Furthermore the observation of only one phase is no absolute proof against the other. The contradiction resulting from the method used by these authors is plainly evident, for the author in the New Manual tells that the flowers appear on the branches; while the authors of Britton's Manual and Small's Flora state on the contrary that the flowers are borne on radical shoots. It was the duty of these authors to retain both diagnostic characters and place the responsibility on Chapman, a botanist of sufficient ability to

[1] l. c. p. 158. 1905.

[2] l. c. p. 161. 1903.

make correct observations on such conspicuous characters. In case this should not have satisfied the authors, they could have expressed their doubt in the customary way by placing a question mark after Chapman's statement.

To do justice to Dr. Chapman, in bringing his diagnosis to the test, the results of my own observations are herewith presented. The following short statement is based on observations of the species *Arundinaria tecta* Muhl, and is not, as it might seem, a compilation of the characters of both species, *A. tecta and A. macrosperma*.

The following facts are obtained by observations and collections of plants from a locality where, I am certain, *A. macrosperma* does not occur, namely, about St. Bernard, Cullman County, Northern Alabama. Mohr in his Plant Life of Alabama[1] expressly excludes the table lands in his report on the habitat of *A. tecta* ,but this report is superseded, at least in part, by later discoveries.

According to my observations the inflorescence on *Arundinaria tecta* Muhl is borne on the so called leafless radical culms (2-9 dm. high) of the season and with sheaths terminated by minute blades: on leafly radical culms of the season with blades somewhat dissimilar in size and appearance from those of the vegetative culms, 10 cm.; or less long and 1 cm. or less wide: on radical culms of the season with blades rather similar to those of the vegetative culms; culms and leaf blades of moderate size: on the summit of leafly branched and unbranched culms of the season, similar to the vegetative culms in size and appearance: on the summit of the culm and the end of the branches of leafly branched culms of the season, and of the same habit as moderately branched vegetative culms. Occasionally branched culms of the preceding season were found with profuse flowering branches, which arose from the crowded sheaths of the ultimate branches of the previous year. The leaves in these cases had fallen during the winter.

Spikelets 6.5 cm. long, and also spikelets up to 15-flowered have been observed. (Herb. St. Bernard College, Nos. 445 and 446.)

St. Bernard College,
St. Bernard, Ala.

[1] Pl. L. of Ala. Contrib. U. S. Nat. Herb. 6:389. 1901.

The Biological Significance of Selective Adsorption.

BY JEAN DUFRENOY.

Modern biologists come more and more to view living matter in the light of colloid complexes, of which those constituting nucleo and cytoplasma may be termed "cyto-colloids," whereas those building cell-walls or intercellular spaces may be named "histo-colloids."

Adsorption is a most important property of colloids. Adsorption indeed, is most satisfactorily explained as a concentration of a solute at a surface, and colloids offer much useful surface.

Certain surfaces not only have the power of adsorbing a solute as a whole from solution, but have the power of adsorbing a part of a solute at a greater rate than the other.

That an ion may be thus selectively adsorbed from an electrolyte, concomitant or previous hydrolysis of the electrolyte is of course necessary.

Living matter being colloidal, is possessing selective adsorbing properties, which may tentatively furnish an explanation of the metabolic processes in the living being, and of the migration of solutes into the cells, or of the color reaction of the tissues.

A most convenient biocolloid to experiment on, was furnished to us by the mucous deposits in the thermal springs of Barèges (Pyrénées). These deposits long known as "Barégine" are zooglæ secreted by various Bacteriacea. True Baregine, as defined by us, is a furfuroïd, soluble in xanthogenate reagents, as distinguished from the cell wall proper of the Bacteria, which is made up of nonsoluble chitin-like material. [8, 11.]

1.—Basophilous Adsorption.

Many vegetable histo-colloids have a superior adsorbent capacity for bases, and redden blue litmus, (which is a salt, containing a strong base, while the acid is the red dye itself.)

This reddening is easily observed in the case of Barégine by the following experiments: (1.) Blue litmus which is made to filter through a plug of Barégine, first filters red, and later on filters uncolored. (2) Blue litmus, kept in a glass tube above a plug of Barégine, reddens, and in a few hours loses its color from its

contact to the Barégine upwards. In both cases, adsorption is selective at first, and total ultimately.

2.—Consequences of Basophilous Adsorption.

There is a struggle for bases constantly going on between basophilous colloids in the plant and those in the habitat. This is most conveniently studied in the cases of unicellular plants: Iron-bacteria, Diatoms, but it is as important for flowering plants in the field. But even the different parts of the same plants struggle for bases, and this should be studied first.

1.—Metachromasia.

Many blue dyes are salts, containing colored base and acid radicals. Either the base or the acid, when free, may be itself a red dye.

Whenever basophilous substances are in contact with these blue salts containing a red free base, they color red, by adsorbing the red base.

The red color displayed by colloids bathing in blue solutions is termed metachromatic.

Therefore, most cases[1] of metachromasia readily explain by selective adsorption, and we actually observed substances which color metachromatically to be basophilous: For instance, such zooglæ in the Barégine, which adsorb Fe or Cu as bases from their salts, also color red by basic blues (Naphtylen blue, Methylen blue.)

The same explanation no doubt holds for cyto-colloids; and the so called "metachromatic granules" in the cells certainly are basophilous gels (or maybe sols). Indeed, metachromatic granules were artificially produced, where metachromasia is the result of selective basophilous adsorption: A drop of a xanthogenate (obtained by dissolving Barégine into CS_2+KOH mixture) being placed in contact with a drop of aqueous solution of naphtylen blue or Polychrome blue, it appears an emulsion of tiny red granules, exactly alike the metachromatic granules in the cells.

Metachromatic granules are conspicuous substances in the cell,

[1] Some cases may result of different colors displayed by the same solute as its solvent changes, as assumed by Moreau.[2] In fact, we found the "insoluble blue acid of the Congo, to yield a red solution in Amylic alcohol.

[2] F. Moreau, Sur les phéno. de métachromasie: *Bull. Soc. bot. France*, t. 63, p. 72, 1916.

but their significance is still doubtful. They have been demonstrated by Guilliermond and Moreau [15, 19] to be secreted by mitochondria, and, in that respect, it is to be noted that in the Sulfuro-bacteriacea such as *Thiothrix sp.*, free sulfur, in the form of intra-cellular globules, deposits only in contact of or inside of metachromatic granules.

Other substances, such as oxalate of potassium, were often found in cells the content of which had degenerated into a basophilous substance, and the relations of basophilous biccolloids to salts in the cell, demand further investigation. That it may be of biological interest appears from the fact that, while nucleo-chromatine is acidophilous in healthy cells, it shows marked basophily in tumour cells of Pines. [8]

This change may result from an altered proportion between base-adsorbent and acid-adsorbent nucleo compounds, or it may be that bases becoming deficient, the base-requirement of the acid nucleo-compounds is no more satisfied.

2.—Struggle for Bases from Host to Parasite.

Marked basophily is often observed in diseased tissues, due to development of much pectic material. [6]

Basophily is conspicuous in the wood of trees, where it is infected by mistletoe. Which wood was found by Councler to be deficient in Ca, but to be rich in PO_4H_3 and K_2O. Basophilous degenerescence may offer to the parasitized tissue a way to oppose the migration of bases from host to parasite.

3.—Iron Deposing Bacteria.

Adsorption again plays an important rôle in the depositing of iron ore by "iron bacteria."

The phenomena is easily studied in the hottest thermal springs of Barèges ($t° = 42°.8$ cent.) where *Ferro-coccus* were observed at various stages of development.

At first they are free, isolated or actively-dividing, highly refringent and thin-walled globules, imbedded in a basophilous zooglæ. Later on, they crowd as *Staphylo-coccus*, their walls thicken and become impregnated with Iron, (easily precipitated blue by Hydrochloric ferrocyanide or red by Sulfocyanide of Potassium.)

The older *Staphyloccus* ultimately form a thin rusty crust, of

which the iron is no more soluble, or at least is not more interchangeable with other bases such as Cu.

Although biochemical reactions may be efficient in changing the soluble iron salts from the thermal water, into the non-soluble iron hydroxide, the adsorbing effect of the cell walls plays a great rôle: in fact, Fe or Cu ions may be fixed in a few minutes by Barégine, and those parts which fix the metal most energically are also those which show the greatest basophily.

It seems therefore that Fe ions are at first adsorbed from the solutions and then biochemically oxydized.

4. Diatoms.

Building of siliceous skeletons by Diatoms was compared by Cohn to depositing of iron by Iron-bacteria.

Indeed, we found that *Synedra affinis*, growing in the Bassin d'Arcachon, near to rusting iron pieces, had developed a rusty color. Moreover, we were able to grow rusty Diatoms in very weak solutions of Iron sulphates in sea water. These rusty Diatoms yielded Prussian Blue, by treatment with hydrochloride ferrocyanide.

Here again we may turn to adsorption for an explanation; Diatoms possess, inside of their siliceous skeleton, a very thin pectic wall, which may adsorb metallic ions, and which we made even to adsorb Cu.

5.—Struggle for Bases from Soil to Plant.

Most plants are in contact with the soil through the basophilous pectic walls of their root-hairs.

These walls compete for bases with the basophilous compounds in the soil.

Bases may be in excess in soils and then easily obtainable by plants, or they may be strongly fixed by the basophilous complex in the soil, such as humic acids, iron hydorxyde . . . the soil being then termed "acid." Most plants thrive on the former soils, but there are few able to live on "acid soils." The former plants have been demonstrated to possess but feeble adsorbent power towards Ca ions, while the latter have a high competing power for bases. [17.]

3.—Acidophilous Adsorption.

Some colloids, such as the basic gels: oxides of Z, Th, Al, La, Zn, Be, Fe and Cr, or celluloses, adsorb the acid more quickly

than the base from dissolved salts. Cellulose is widely distributed in vegetable cell walls, where it is associated to pectic acid. Most cell walls therefore may adsorb basic colors by their pectic membrane, and acid dyes by their cellulos constituents.

Adsorption of acid dyes, such as Congo red, Eosine, Fuchsin . . . is conspicuous in the cell-walls of Sulfuro-bacteriacea, *Thiothrix*. . . . It is even so strong, that a small quantity of *Thiothrix* placed in a solution entirely loses color.

Acidophilous basic gels being widely distributed in the habitat and in histological tissues, may exert an adsorbent effect on the acid ions in the cell, which effect demands investigation.

4. Reactions Accompanying Adsorption.

Thermal waters from Barèges' springs redden blue Congo by warming.

This may be accounted for by supposing that basic gels exist in the thermal waters, which adsorb the acid of Congo red at ordinary temperature, without change in the color, which remains blue; on warming, chemical reaction takes place and a salt of Congo red is formed, a red color appearing. At the same time, an insoluble blue acid of the Congo is precipitated, which may again yield interesting adsorbent effect.

Such reactions have called for the attention of numerous investigators and Wedekind and Rheinboldt conclude that adsorption effect may often precede chemical union, which seems specially true of biochemical reaction as was observed for iron depositing bacteria.

Summary.

1. The compounds, in living cells or tissues, are colloids displaying selective adsorption effect.

The constituents of cell walls and most granules in the cytoplasm are base-adsorbent colloids; they compete for bases, each with the other, and with the basophilous colloids in the habitat.

The constituents of nucleoplasma are generally acid-adsorbent, but may become base adsorbent in diseased cells.

Cellulose, an acid-adsorbent colloid, is widely distributed in plant cells and may exert powerful adsorption towards acids.

2. Adsorption effect may be preliminary to biochemical reaction, as is probably the case for iron depositing bacteria.

3. Competition for bases may result in serious loss of bases in

the habitat, and considerable accumulation of bases in plant tissues.

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Sexual Dimorphism and Some of Its Correlations in the Shells of Certain Species of Najades.

BY N. M. GRIER, PH. D.

I.—INTRODUCTORY.

Before Ortmann's discovery that the sex of Najades could be readily learned from associated peculiarities of gill structure, (4, 5,), systematists had only general information—of the type later to be compared in this paper—from which to identify the sex of a mussel when glochidia were absent. Hazy, (2), and Israel, (3), were able to distinguish the sexes of certain European species by such characters as relative length, height, and inflation. Israel, particularly, found associated with sex, certain colors of the epidermis of the shell. The investigations of these latter writers extended only to 3 species, none of which are closely related to those dealt with in this paper, and their original work never seems to have been followed up. In addition there occur in the papers of American investigators from time to time, scattered references to the sexual dimorphism of certain species based on some morphological feature of the shell. Such, however, are either not concerned with the species we are interested in, or are already summarized by Simpson, (6), or Walker, (8), whose information later will be brought out.

II.—PROBLEM, METHOD, AND MATERIAL.

While pursuing another investigation on the comparative morphological characteristics of certain mussel shells inhabiting the Upper Ohio Drainage and their corresponding ones in Lake Erie, (1) the writer obtained data of the type indicated, which he

proposes in this paper to associate as far as possible with the sex of the shells examined.

The material used was Dr. A. E. Ortmann's splendid collection of shells in the Carnegie Museum at Pittsburgh, Pa., and while the most complete account of how these measurements were taken is reserved until the publication of the research spoken of, the method of making them is described to what is believed to be a comprehensible extent in the accompaning table dealing with sexual dimorphism. Here it may suffice to state that the dimensions taken were 7 in number and included the measurement of,

1.—Relative degree of inflation.
2.—Height.
3.—Posterior length of shell.
4.—Anterior length of shell.
5.—Length of posterior hinge line.
6.—Length of anterior hinge line.
7.—Thickness of shell—in this investigation taken just superior to the pallial line in the region directly beneath the umbo

In making these measurements an ordinary metric caliper and rule were used, the values obtained reduced to convenient factors by division into the length, with the exception of that of thickness, which it seemed desirable to compare with the height.

Measurements were made on the following genera and species, viz.,

Fusconija flava, Raf. — *Paraptera fragilis, Raf.*
Amblema costata, Raf. — *Proptera alata, Say.*
Pleurobema obliquum coccineum, Con. — *Anodontoides ferussacianus, Lea*
Elliptio dilatatus, Raf. — *Eurynia recta latissima, Raf.*
Symphynota costata, Raf. — *Lampsilis luteola, Lam.*
Anodonta grandis, Say. — *Lampilis ovata ventricosa, Lam.*

The factors above described having been obtained, it was the practice while making comparisons in the endeavor to associate any of the 7 measured morphological dimensions with the sex of the shell, to compare equal numbers of both sexes of the species. An average was made of the values obtained by calculation for each dimension of the shell, and then this result compared with that similarly obtained from the other sex of the animal. A table (I) showing the averages for each dimension of that sex of each species is appended, and from the comparison of its values, the table on Sexual Dimorphism (II) is obtained.

III.—Results.

(*a.*) *Conclusions.*

In more condensed form the results given in the tables may be expressed as follows.

1. *Males of Pleurobema, Elliptio, Symphynota, and Proptero possess a greater height and degree of inflation than females and are relatively shorter. The females of Fusconaja, Amblema, Eurynia, L. luteola, and L. ovata show opposite characters in this respect to those of females representing the first four named species. Also in the foregoing, height correlates with the degree of inflation of the shell. Males of Anodonta, Anodontoides while having a greater degree of inflation than females, have a less height.*

2. *Males of Elliptio, Anodonta, Paraptera, Anodontoides, Eurynia and L. ovata have a relatively greater length of the posterior part of the shell, and consequently less of the anterior. In the remaining shells this condition is reversed.*

3. *The one outstanding morphological feature associated to preponderating extent with maleness in the Najades dealt with, was the greater length of posterior hinge line, (the anterior seems best developed in the females). These facts correlate with values for anterior and posterior length in ½ the species only.*

4. *Thickness of shell, as associated with sex, seems to be as equally indifferent as all the other dimensions, (with the exception of those of the hinge lines).*

(*b.*) *Remarks.*

There is now given from Simpson, (6), Walker, (8), Utterback, (7), all descriptive material of the external morphology of these shells usually held to be associated with the different sexes. As a rule, emphasis is placed on Walker's late work, and it is the writer's desire to show the relation of this material to the results he has obtained.

Utterback believed females of *Fusconaja* and *Symphynota* to possess a greater degree of inflation of the shell. My results check only with the former in this respect. We must pass over the other species listed in the order given (for the reason that there seems to be no accredited descriptive material concerning their Sexual Dimorphism), until we come to *Paraptera.*

Simpson: *Paraptera.* "Female and male much alike, former sometimes a little rhomboid or again it ends in a wide rounded point

TABLE II.

SEXUAL DIMORPHISM IN NAYADES.

(Dextro-sinistral diameter $\frac{DSD}{L}$ or convexity of valve divided by length giving *degree* of *inflqtion*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Pleurobema coccineum	15	27	Fusconajo flava
Elliptia dilatatus	15	19	Amblema plicata
Symphynota costata	5	33	Eurynia recta
Anodonta grandis	8	94	Lampsilis luteola
Paraptera fragilis	5	84	Lampsilis ovata
Proptera alata	6		
Anadontoides ferussacianus	3		

(Dorso-ventral diameter of $\frac{DVD}{L}$ value divided by length giving *relative height.*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Pleurobema	15	27	Fusconaja
Symphynota	5	19	Amblema
Elliptio	15	8	Anodonta
Proptera	6	5	Paraptera
Eurynia	33	8	Anodontoides
		94	L. luteola
		84	L. ovata

(Distance posterior to extremity $\frac{PD}{L}$ from aline passing through median dorsal plane of valve expressing *relative;degree posterior development shell.*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Elliptio	15	27	Fusconaja
Anodonta	8	19	Amblema
Paraptera	5	15	Pleurobema
Anodontoides	3	5	Symphynota
Eurynia	33	6	Proptera
L. ovata	84	94	L. luteola

(Distance anterior to extremity $\frac{AD}{L}$ from a line passing through median dorsal plane of valve expressing *relative degree anterior development shell.*)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Fusconaja	27	15	Elliptio
Amblema	19	8	Anodonta
Pleurobema	15	5	Paraptera
Symphynota	5	3	Anadontoides
Proptera	6	33	Eurynia
L. luteola	94	84	L. ovata

(Length of shell compared $\frac{PHL}{L}$ with that of posterior hinge line.)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Fusconaja	27	5	Symphynota
Amblema	19	6	Proptera
Pleurobema	15	5	Paraptera
Elliptio	15		
Anodonta	8		
Anodontoides	3		
Eurynia	33		
L. luteola	94		
L. ovata	84		

(Length of shell compared $\frac{AHL}{L}$ with that of anterior hinge line.)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Symphynota	5	27	Fusconaja
Proptera	6	19	Amblema
Paraptera	5	15	Pleurobema
		15	Elliptio
		8	Anodonta
		3	Anodontoides
		33	Eurynia
		94	L. luteola
		84	L. ovata

(Thickness of shell divided $\frac{TH}{DV\,D}$ by dorso-ventral diameter.)

Male Greater this Respect in	No. spec. measured of each		Female Greater this Respect in
Pleurobema	15	27	Fusconaja
Elliptio	8	19	Amblema
Anodonta	8	5	Symphynota
Proptera	6	5	Paraptera
Anodontoides	3	94	L. luteola
Eurynia	33		
L. ovata	84		

about in the median line. Female shell a little fuller and more rounded in the post-basal region." Specimens of Paraptera were not abundant, but if in this species "rhomboidal" may generally imply a greater height compared with the length, there is some agreement on the part of my results. Inflation of the post-basal region was not measured.

Proptera: "Female shell with long rounded marsupial swelling at extreme post-basal part, generally sub-truncate behind. Male shell less full in post basal region, nearly rounded behind." My

observations do not agree with calculations from Walker's illustration of this species which shows the female to be relatively higher. They do agree in assigning the female a greater posterior length of shell.

Eurynia: "Male shell drawn out behind and ends in a blunt point about midway up from the base. Female shell has long rounded marsupial swelling, ending in a blunt point ⅔ way up from the base." This data agrees with my measurements, as it may be inferred the male is longer, the marsupial swelling may be in evidence from the inflation of the shell at the point measured.

L. luteola: "Female shell with most decided marsupial swelling; here blunt posterior point is somewhat higher up, ($\frac{3}{6}$), of height than that of male, (about halfway), and is usually more inflated." My results show the female as a higher degree of inflation, and is besides relatively longer.

L. ovata: "Female shell slightly inflated post-basal region," etc. As the recorded dimorphism for this genus is practically the same as for these last 2 species, I need only point out the full accord with my results.

The value of quantitative studies of the morphological characteristics of shells is best appreciated when cases are brought back to mind where new genera and species had to be founded on the anatomy of soft parts alone so great was the superficial resemblance in some cases between what turn out to be entirely different animals. If as a general proposition, it be admitted that the systematist should be able to find in any organism *specific characters* distributed from the most minute anatomy to the coarsest features of morphology, any such convergent phenomena as described above could be eleminated as each species of shell could be expected to vary in morphological characters around its own mean. It is to be hoped that the practice of publishing the more usual dimensions for *both* sexes of shells will be continued, that the ultimate philosophic trend of all Biological Science may have ample data for the consideration of the never-dying and always-puzzling question of the environment.

(*c.*) *Source of Error.*

Paucity of material compelled me to use in some species a few shells from Lake Erie, (most were from the Upper Ohio Drainage), although it is in some of the measured shell characteristics, as I expect to show, that the Lake Erie shells differ from those of the

Upper Ohio. I do not feel, however, that the value of my conclusions is greatly impaired thereby, as an equal number of shells of both sexes from Lake Erie was included when this had to be done. Besides the reduction to factors apparently expresses the relative proportion of the part concerned, and, by the law of averages, possibly evens up any great differences.

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TABLE I.

GIVING AVERAGE DIMENSIONS OF MALE AND FEMALE SHELLS.

NO. SPECIMENS	MUSSEL	SEX	DSD/L	DVD/L	PD/L	AD/L	PHL/L	AHL/L	TH./DVD
27	Fusconaja flava	♀	.5294	.7756	.7749	.2315	.4867	.2499	.119
27	Fusconaja flava	♂	.4838	.7710	.7550	.2308	.544	.2001	.1181
19	Amblema plicata	♀	.409	.710	.806	.198	.574	.184	.1398
19	Amblema plicata	♂	.437	.7680	.813	.1892	.565	.184	.1699
15	Pleurobema obliquumcoc	♀	.436	.796	.845	.1552	.594	.1987	.43
15	Pleurobema obliquumcoc	♂	.442	.821	.78	.2145	.575	.1973	.27
15	Elliptio dilatatus	♀	.297	.494	.774	.2115	.509	.1830	.24
15	Elliptio dilatatus	♂	.304	.505	.796	.2026	.544	.1615	.22
5	Symphynota costata	♀	.260	.566	.744	.256	.490	.1924	.24
5	Symphynota costata	♂	.287	.586	.729	.270	.497	.253	.26

8 Anodonto grandis	♀	.372	.567	.716	.277	.418	.216	.061
8 Anodonto grandis	♂	.382	.561	.709	.288	.419	.243	.062
3 Anodontoides ferussac	♀	.373	.517	.763	.306	.472	.242	.40
3 Anodontoides ferussac	♂	.357	.518	.754	.248	.436	.182	.35
5 Paraptera fragilis	♀	.355	.751	.734	.268	.502	.2081	.10
5 Paraptera fragilis	♂	.304	.696	.737	.267	.491	.2215	.16
6 Proptera alata	♀	.361	.775	.684	.315	.539	.219	.34
6 Proptera alata	♂	.373	.825	.708	.292	.561	.2185	.19
33 Eurynia recta	♀	.2740	.412	.774	.2229	.540	.1676	.55
33 Eurynia recta	♂	.2703	.4177	.798	.207	.560	.1616	.28
94 Lampsilis luteola	♀	.4027	.6036	.7603	.2739	.5184	.2478	.38
94 Lampsilis luteola	♂	.3708	.5617	.7319	.2593	.4878	.2191	.38
84 Lampsilis ovata vent.	♀	.4780	.7375	.6885	.3105	.4490	.2314	.39
84 Lampsilis ovata vent.	♂	.4660	.716	.706	.297	.451	.2319	.38

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The Prairie Mirage.

BY HOWARD C. BROWN.

Strange is it indeed, that to so many persons who have spent their lives upon the prairie, a mirage is something which is far distant; a thing entirely unrelated to their life. Many persons associate the mirage only with the desert. This seems odd enough when one considers the many beautiful mirages which appear in the prairie skies when a reflected grass area seems only a further extension of the vast, real stretch, which, in great, gentle waves of Titanic magnitude, roll, of a prairie morning, in undulating green, wind responsiveness, under the lifting sun. Few things can inspire one with more sincere thoughts of the greatness of the universe, than can the wide stretches of prairie of our land. And the mirages are interesting to me in that they were often so thoroughly linked, in the past, with the life of the pioneer.

If he loved beauty, the pioneer never ceased to revel in those wondrous reflections. But the mirage was not alone a thing of beauty. If it mirrored an enemy's camp, in time of hostilities, it served a utilitarian purpose. But to those who did not love it for its beauty, and for whom it served no real purpose, still it became

an object of wonder, and they never ceased to marvel at the unusual phenomenon.

Mrs. Maude A. Fenton, a member of the California Naturalist Club, is a thorough lover of beauty. For a number of years she lived near Indian Head, Canada. Writing of those years, she said that her most pleasant memories of Canada were centered about her enjoyment of the wild flowers, the northern lights, and the mirages. Speaking of the last mentioned, she says, "Situated some seven miles from Indian Head, was the Squirrel Hill, at the foot of which was a very large spring of water. From it the town of Indian Head had its water piped to the town. One bright, frosty morning in the spring of 1907, we noticed what we thought to be about half a mile away, this hill with all the trees, hollows and the place where the spring was, showing quite plainly. On speaking to others about it, they said, 'Yes, but you saw the hill when the mirage was on, for it is over seven miles away."

"Another time in November, 1908, one bright, clear morning I thought that some one had been moving a house and left it in the corner of the pasture land, about one-fourth of a mile away. Both Mr. Fenton and I were deceived into thinking that it was a real house which had been moved during the night, for we knew that it had not been there the day before. On closer examination we found it to be our neighbor's house some two miles away, to the north-east. It stayed there about two hours, and then gradually faded away, back to the place where it belonged.

"During the same winter, we had the chance of seeing the most beautiful one of all, the Katepwa valley. This valley is situated some fourteen miles from Indian Head, and sixteen miles from where we lived. Lake Katepwa is in the center of this valley, and surrounding it are quite high hills with trees, shrubbery, hollows and roads. Also, a few houses. Snow was on the ground. As we had been there a couple of times it did not take us long to name the place. It looked very natural. This was brought to our view about a mile away. The Hills lay to the south-west of us, the house to the north-east, and the valley north-west, and everything showed right side up. These mirages always occurred in the morning, just about sunrise. We never saw one in the evening."

One of the most interesting references to the prairie mirage which I have yet found, is in J. W. Winkley's "John Brown, the

Hero." He tells about a horseman who had been riding full speed up the creek, one morning in 1856, and who stopped at their cabin door. The horseman brought news that the Ruffians were over the border, upon them again, in strong force. He was a messenger from the Middle River region, and had been dispatched to them by his comrades in distress. His mission was, of course, to secure help. The need was urgent. Then there comes the description of the mirage, "As the speaker drew his narration to a close, all present instinctively turned their eyes in the direction whence he had come: namely, toward the south-east. There a sight met our gaze that riveted us to the spot—a spectacle as marvelous as it was beautiful, and singularly confirmatory of our informer's words. To our utter astonishment we looked directly at that moment into the enemy's camp twenty miles away, though seemingly less than a quarter of that distance. It was one of those peculiar phenomena, rarely seen on the water and less frequently on the land, and more wonderful in the latter case when it does thus appear, because the more perfect and on a grander scale: the mirage."

"The prairie mirage is of wondrous beauty. It is usually in the autumn, when all the atmospheric conditions are favorable, that these strange illusions take place on the prairie ocean. Along the eastern horizon, near sunrise, a narrow belt of silver light appears. As it grows broader the silvery gray of its lower side changes slightly golden. Fleecy clouds above the belt take on a yellow red. The grayish shadows of the dawn lift slowly from the earth. Just before the red disk of the sun peers above the horizon-line, one sees in the sky the landscape of trees, of waving grasses or grain, or rocks and hills, held together as it were by threads of yellow and gray and azure. The earth stands inverted in the air.

"The groundwork of this illusion is grayish, semi-opaque mist; and the objects are seen standing or moving along in it. The feet of animals and of men, the trunks of trees, the rocks and hillocks, are set in this aqueous soil. When the conditions are perfect, objects far beyond the range of vision over the prairie are brought near and into plain view of the beholder.

"That morning was such a time and afforded such a scene. There was the camp of the enemy,—miles away, as has been said,—mirrored perfectly and beautifully on the sky, every feature of it traced with the minuteness of a line-engraving. By the aid of our

military field-glass we could see the early risers moving through the campground; the horses standing patiently outside awaiting their morning meal; the positions of the pickets keeping guard; the tent doors flapping in the slight breeze or swaying back and forth as the men made egress or entrance. Even the curling smoke of the newly kindled flame, as it ascended upward, curiously traced itself visibly to the eye."

I was greatly interested in the mirages of which Iowan early settlers have told. And I wanted to know also, how far the mirage could be seen. In answer to my inquiries, Mr. Clement L. Webster, who has for years been collecting pioneer data, writes, "I do not just as this moment recall of my having personally seen one of the mirages in this part of the west (Iowa) but I recall the description which some of the old settlers have given to them, which they saw in the north-central part, and north-west parts of Iowa, in the very early days. As they described them to me, they must have been reflections of the South Dakota prairies. I was very familiar with mirages in the south-west."

One of the most recent mirages of the north-central Iowa region, of which I have any record, was one which was seen at Charles City, Iowa, by Mrs. Mary Dutton. "It was November 29th, 1918, or there about, that I saw this reflection," writes Mrs. Dutton. "I hastily threw a shawl about my shoulders and stood alone in the dingy light of the old attic, in the cold, for one and a half hours, wrapped in awe. I did not realize that time was passing, until my mother became alarmed at my long absence. I found that to view it from the ground gave a distinctly different impression. Our house is on a hill and from the third story window I got the best view. The clouds seemed to change and form different angles when I got up stairs. The heavens, for the entire circle around was beautifully colored with stripings of pink and green, seemed to glow. This alone was most beautiful. At the movies when they run the pictures and adds so that they appear liks kaleidoscopic bits of color or form, and then seem to slide unbidden to position, until the picture desired has materialized, you have an effect which is not unlike that which is witnessed at the beginning of the reflection. All of the arrangements of cloud and color were finally produced, and the almost perfect reflection was displayed. It remained for analysis and comprehension for some time, practically unchanged, making recognition quite certain, and not allowing

chance for imagination, in a chance cloud formation. The sun was setting in that great blaze of subdued red, and was farther west than the mirage. The clouds which bore the mirage hung unsuspended to the south and between us and the horizon, which held yet another bank of strangely shaped, gray clouds. As to the details of the mirage, I know that it was the Mississippi bluffs which I saw reflected. There was the main river, the further bank being indistinct, but the bluffs on this side were very plain. And yet towards me from the river, was an inlet or a back water pond, that was very distinct. The shore line of this showed a boulder in the edge of the water."

The Mississippi bluffs are fully one-hundred miles distant from Charles City, where the mirage appeared. The same night that this appeared, I had noticed the wondrous colors of the sky, and had telephoned Mrs. Dutton to watch them. But they were going so very fast, that by the time I got back to my observation post, I did not see the same thing which I had phoned about. Then I was busied, and ceased in my watch. And it was apparently at that time that the real mirage began to shape itself.

There is no river the size of the Mississippi and with the bluffs margining it, any place near Charles City. It is a long way for a reflection to carry, but the vivid description which has been given is one of the most interesting of those which I have thus far found. The atmospheric conditions are such that the mirage might easily appear at that time. Most of the ones described have been in the early morning. This was just as the sun was setting. If the sun had dropped below the horizon, then its last rays might have been spent in illuminating just such a reflection as this. The distinct manner of the reflection considering the distance, is one of the most unusual characters of it.

There is much to be learned about the prairie mirage. Many persons could add information concerning it, which would be of value to the collector of data on our natural phenomena. I have collected here some references which I have had of the mirage. There is much which is now waiting to be collected. The lips of the old settlers yet mumble the stories of the early days. But the mumbling will cease e'er long, and then we will not have the records which we should most carefully have collected. Let us then get to work and secure these records before it is too late. All that deals with the early life of the pioneer is sacred to the memory

of the men who live after him. The mirage is only one thing which entered into his life. He was intoxicated at times with the beauty and stunned with the wonder of it. Let us too infuse into our beings some of the wonder and beauty which maintained the pioneer.

Bird Nests Found at Spring Ledge in 1919.

BY FRANK C. EVANS.

I have just completed a record of the bird nests found at Spring Ledge, near Crawfordsville, Indiana, during the past summer, and I thought perhaps the readers of the *American Midland Naturalist* might be interested in the result. I located 146 nests on the grounds, and since the leaves have fallen, have found several others; but these are not included in the record. There were twenty-six species as follows:—

Green Heron	1	Flicker	4
Robin	18	Sparrow Hawk	1
Baltimore Oriole	3	Orchard Oriole	1
House Wren	14	Cuckoo, Yellow-billed	3
Mourning Dove	14	Warbling Vireo	3
Brown Thrasher	3	Catbird	3
Bluebird	6	Chimney Swift	2
Chipping Sparrow	5	Hummingbird	2
Red-headed Woodpecker	2	Meadowlark	6
Purple Martin	38	Maryland Yellow-throat	1
Blue Jay	1	Red-winged Blackbird	3
Kingbird	1	Cedarbird	2
Phoebe	2	Crested Flycatcher	1

I put up sixty-six nesting boxes and shelves—fifty-five boxes and eleven shelves. Twenty-eight boxes were used. Six of the boxes were used twice, and three, three times. Twenty-seven boxes were not used. Eight of these were in the immediate vicinity of a sparrow hawk's nest, which I think account for their not being occupied. Of the eleven shelter shelves, five were used, all by robins.

Our Martin colony was considerably larger this year, and was a source of continual delight throughout the summer. Among our prized nests was a hummingbird's, situated on a limb about six feet above a large spring. If I had been permitted to select the location, I could not have picked a more picturesque spot. It was a

perfect jewel of a nest. We watched the mother bird throughout the period of incubation, and especially enjoyed seeing her feed her baby, bird—only one of the two eggs hatched. I also found a perfect humming bird's nest under a tree, which had evidently been blown from the limb; so we really think we had two hummingbirds' nests, but have no record of one of them.

I shall never again permit a sparrow hawk to nest on the grounds. I am sure he drove many birds away, for often I would observe him perched in the top of a tall oak tree, and suddenly dart like an arrow for smaller birds that happened to alight in his vicinity. Besides, none of the nesting boxes near the sparrow hawk's nest were occupied.

We did not locate a cardinal's nest this year, although the grounds were full of them nearly all the time. I know they were nesting nearby, but we were unable to find the nests.

I wish everyone could appreciate the great returns in pleasure and satisfaction in protecting and attracting the song birds to their home grounds Certainly no other investment brings greater returns.